CLAIMS

WHAT IS CLAIMED:

1. A system for generating an electrical power output from a subsea installation, said subsea installation comprising at least one flowline, said system comprising a turbine operatively connected to said flowline, said turbine being rotatable by fluid flowing through said flowline, and said turbine generating said electrical power output when said turbine is rotated.

2. The system of claim 1, wherein said flowline is a production flowline.

3. The system of claim 1, wherein said flowline is an injection flowline.

4. The system of claim 1, further comprising at least one control valve for regulating a flow of said fluid to said turbine.

5. The system of claim 4, wherein said at least one control valve comprises at least a first position in which fluid flowing through said flowline is directed through said turbine, and a second position in which fluid flowing through said flowline bypasses said turbine.

6. The system of claim 1, further comprising at least one speed sensor for sensing a rotational speed of said turbine.

7. The system of claim 6, wherein said electrical power output comprises an AC signal having a frequency which is proportional to said rotational speed of said turbine, and said at least one speed sensor comprises a frequency sensor for sensing said frequency.

8. The system of claim 7, further comprising:

at least one current sensor for sensing a current produced by said turbine;

a control unit for determining an efficiency of said turbine, said determination of said efficiency being based upon said rotational speed and said current.

9. The system of claim 6, further comprising a control module for determining a flow rate of fluid flowing through said turbine, said determination of said flow rate being based upon said rotational speed sensed by said speed sensor.

10. The system of claim 1, further comprising at least one direction sensor for sensing the direction of rotation of said turbine.

11. The system of claim 10, wherein said electrical power output comprises a three-phase AC signal, and said at least one direction sensor comprises a phase sequence sensor for sensing the sequence of at least two phases of said three-phase AC signal.

12. The system of claim 1, further comprising:

a choke valve connected to said flowline;

a first pressure sensor for sensing a first pressure in said flowline on one side of said choke valve; and

a second pressure sensor for sensing a second pressure in said flowline on the other side of said choke valve.

13. The system of claim 12, further comprising a control module for determining a flow direction of fluid flowing through said choke, said determination of said flow direction being based upon said first and second pressures.

14. The system of claim 13, further comprising a master valve connected to said flowline, said control module controlling said master valve in response to said flow direction.

15. The system of claim 1, further comprising at least one electrically operated component, said electrical power output being supplied to said at least one electrically operated component.

16. The system of claim 15, wherein said at least one electrically operated component comprises a valve actuator.

17. The system of claim 15, wherein said at least one electrically operated component comprises a control module.

18. The system of claim 1, further comprising at least one electrical power storage device, said electrical power output being supplied to said at least one electrical power storage device.

19. The system of claim 18, wherein said at least one electrical power storage device comprises a battery.

20. The system of claim 18, further comprising at least one electrically operated component powered by said at least one electrical power storage device.

21. The system of claim 1, further comprising a control module for controlling said turbine.

22. The system of claim 21, wherein said control module causes said turbine to selectively be in at least a first state wherein said turbine generates electrical power, and a second state wherein said turbine does not generate electrical power.

23. The system of claim 22, further comprising:

at least one electrical power storage device, said electrical power output being supplied to said at least one electrical power storage device; and

at least one charge sensor for sensing the charge level of said at least one electrical power storage device, said charge level determining the selection of said first and second states of said turbine by said control module.

24. The system of claim 1, wherein said turbine comprises:

a rotary member comprising a plurality of blades and at least one rotating magnet; and

a fixed housing comprising at least one stationary magnet, wherein rotation of said rotary member causes relative movement between said at least one rotating magnet and said at least one stationary magnet, said relative motion generating said electrical power output.

25. The system of claim 1, further comprising a closed flow loop in fluid communication with said flowline, said turbine being positioned in said closed flow loop.

26. The system of claim 25, further comprising at least one valve for regulating a flow of said fluid through said closed flow loop.

27. The system of claim 1, further comprising a communication unit for communicating with a control station located remotely from said subsea installation.

28. The system of claim 27, wherein said communication unit comprises at least one acoustic transmitter.

29. The system of claim 27, wherein said communication unit comprises at least one acoustic receiver.

30. A system for generating an electrical power output to support a subsea installation, said subsea installation comprising at least one flowline, said system comprising:

a turbine operatively connected to said flowline, said turbine being rotatable by fluid flowing through said flowline, and said turbine generating said electrical power output when said turbine is rotated;

at least one electrical power storage device, said electrical power output being supplied to said at least one electrical power storage device;

at least one electrically operated component powered by said at least one electrical power storage device.

31. The system of claim 30, wherein said at least one electrically operated component comprises a valve actuator.

32. The system of claim 30, wherein said subsea installation further comprises a subsea Christmas tree.

33. The system of claim 30, further comprising a subsea control module for controlling said system.

34. The system of claim 33, wherein said control module causes said turbine to selectively be in at least a first state wherein said turbine generates electrical power, and a second state wherein said turbine does not generate electrical power.

35. The system of claim 34, further comprising at least one charge sensor for sensing the charge level of said at least one electrical power storage device, said charge level determining the selection of said first and second states of said turbine by said control module.

36. The system of claim 30, further comprising a closed flow loop in fluid communication with said flowline, said turbine being positioned in said closed flow loop.

37. The system of claim 36, wherein said closed flow loop is retrievable using an ROV.

38. A method for generating an electrical power output from a subsea installation comprising at least one flowline, said method comprising:

operatively connecting a turbine to said flowline; and

directing a flow of fluid through said turbine to thereby generate said electrical power output.

39. The method of claim 38, further comprising sensing a rotational speed of said turbine.

40. The method of claim 39, further comprising:

sensing a current produced by said turbine; and

determining an efficiency of said turbine, said determination of said efficiency being based upon said rotational speed and said current.

41. The method of claim 39, further comprising determining a flow rate of said fluid flowing through said turbine, said determination of said flow rate being based upon said rotational speed.

42. The method of claim 38, further comprising sensing a direction of rotation of said turbine.

43. The method of claim 38, further comprising:

connecting a choke valve to said flowline;

sensing a first pressure in said flowline on one side of said choke valve; and

sensing a second pressure in said flowline on the other side of said choke valve.

44. The method of claim 43, further comprising determining a flow direction of fluid flowing through said choke valve, said determination of said flow direction being based upon said first and second pressures.

45. The method of claim 44, further comprising:

connecting a master valve to said flowline;

controlling said master valve in response to said flow direction.

46. The method of claim 38, further comprising supplying said electrical power output to at least one electrically operated device.

47. The method of claim 38, further comprising supplying said electrical power output to at least one electrical power storage device.

48. The method of claim 47, further comprising powering at least one electrically operated device with said at least one electrical power storage device.

49. The method of claim 47, further comprising:

sensing a charge level of said at least one electrical power storage device; and

when said charge level is below a first predetermined value, causing said turbine to be in a first state wherein said turbine generates electrical power.

50. The method of claim 49, further comprising:

when said charge level is above a second predetermined value, causing said turbine to be in a second state wherein said turbine does not generate electrical power.

51. The method of claim 38, further comprising:

locating a control station remotely from said subsea installation; and

communicating acoustically between said subsea installation and said control station.